

A Review Paper on Comparative Analysis of C++, JAVA, PYTHON

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Abstract - C++ ,Java and python all are object-oriented programming languages. Yet, these languages differ from one another in many ways. Object Oriented Programming (OOP) utilizes an alternate arrangement of programming language than old procedural programming dialects (C, Pascal, and so forth.). It is a methodology which is essentially centered on the way objects collaborate to convey and share the data. It changed the utilization of procedural oriented programming, where the attention was on the methodology of execution. The object oriented methodology brought another way, giving more significance to the items.

KeyWords: Code, Compiler, C++, Java, Programming ,Python, Comparison

2. Overview

2.1 Overview of C++

C++ was created much before Java. Back in 1979, amid working on simula language, Bjarne Stroustrup came to know about a new object-oriented programming language that treats each component separately, then he decided to work on C language amid launched C++ in 1983 that was a variant of C with classes (Cplusplus.com, 2013). The team changed it into C++ in 1983 to represent an advanced operator. Later coming to 1985, C++ was seen use as a commercial product.

C++ supports both object-oriented and procedure-oriented programming but actually, it is an Object-Oriented Programming language that is largely used in real-world applications. It is considered to be an efficient language in terms of memory and speed as compared to other programming languages like Java, python, etc

➤ Features of C++

a. Platform Dependent

Platform dependent language means the language in which programs can be executed only on that operating system where it is developed & compiled. It cannot run or execute it on any other operating system.

b. Structured programming language

In C++ programming, the code is modular with the help of functions, classes & objects, and the modules are loosely coupled. Modular code is easy to understand & modify. This makes C++ a structured programming language.

c. Rich Library

Developers have access to lots of in-built functions provided by [C++ language](#). This saves time & makes development fast.

d. Memory Management

C++ supports dynamic memory allocation. You can free the allocated memory at any time. Not only this C++ also provides dynamic memory management techniques.

e. Powerful & Fast

C++ is a fast language as compilation and execution time is less. Also, it has a wide variety of data types, functions & operators.

f. Pointers

Pointers are variables that store the address of another variable. Pointer points to the memory location of a variable. C++ supports pointer and provides solutions to lots of problems that demand access to memory location.

g. Compiler based

C++ is a compiler-based programming language. Without compilation, no C++ program can be executed. The compiler first compiles the C++ program and then it is executed.

h. C++ Features: Syntax based language

C++ is a language that complies strongly with syntax. Language following rules and regulations very strictly is known as tight syntax-based language. C, C++, [Java](#), .net are some of the examples.

2.2 Overview of JAVA

James Gosling at Sun Microsystems was the first person who initiated the Java language project in 1991 for the embedded systems in electronic appliances. The simplest principle behind creating Java accounts simple, robust, portable, platform-independent, high secured, dynamic etc. Their creator used well-known C style syntax to make its base. From initiation to its latest development, there has been a series of Java language launched out of which Java SE 13 is the newest one. This attributed to significant difference of C++ Vs Java when we learn about its origination. Java was mainly designed for application programming and has a functionality of an interpreter for printing systems which was later developed into network computing. many features of C++ and Java are common other than that below are the features of Java

➤ Features of Java.

- **Object-oriented:-**Java is fully object-oriented. The OOP helps in dealing with real-world applications. The inclusion of inheritance, polymorphism, abstraction, and encapsulation makes a program an OOP.
- **Platform Independent:-**When compiling a program, it is compiled into a platform-independent byte code which is then executed using a Java Virtual Machine (JVM). The use of JVM makes Java programming platform-independent since if JVM is installed the same program can be executed in multiple platforms
- **Secured :-** Java uses its own runtime environment i.e., JVM, Java applications are secure. Safety aspects like Type-checking at compile time and runtime checking are found inbuilt in Java. Java is also known for the security that it provides. Java also lacks pointers, which encourages security.
- **Robust :-**Java has strong memory management and it automatically gets rid of objects that are not used. Java consists of exception handling and types of checking techniques. All these features of Java make it robust.
- **Portable :-** Java byte code can be transferred to any platform without any implementation making it portable.
- **Multi-thread :-**The features of multi-threading are inbuilt in Java. It aids in building highly interactive and responsive applications that deal with many tasks at once. Multi Threads share a common memory area, increase the capabilities and performance.
- **Distributed :-** This aspect of Java allows accessing files by calling the methods from any machine on the internet. It supports the sharing of data and programs among multiple computers for networking that is intrinsically integrated into it. Java supports RMI (Remote Method Invocation), Socket Programming, and the COBRA that aid in sharing objects in a distributed environment.

2.3 Overview of PYTHON

Python was designed by Guido van Rossum in the 1990s as a side project and developed by Python Software Foundation. It was named after the BBC's TV show – "Monty Python's Flying Circus".

Python is currently one of the most popular dynamic programming languages, along with others such as Perl, Ruby, etc. It is a popular high-level programming language with high code readability. Unlike other languages such as C++, C, Java, etc, it uses indentation instead of brackets and semicolons. It started gaining popularity in 2003 and now in 2020 according to PYPL Popularity of Programming Language Index, Python tops the chart. There are two broad versions of Python namely, 2.x and 3.x. It supports programming paradigms such as functional, procedural, reflective, imperative, and object-oriented approaches

➤ Python's feature highlights include:

- **Easy-to-learn:** Python has relatively few keywords, simple structure, and a clearly defined syntax. This allows the student to pick up the language in a relatively short period of time.
- **Easy-to-read:** Python code is much more clearly defined and visible to the eyes.

- **Easy-to-maintain:** Python's success is that its source code is fairly easy-to-maintain.
- **A broad standard library:** One of Python's greatest strengths is the bulk of the library is very portable and cross-platform compatible on Unix, Windows and Macintosh.
- **Interactive Mode:** Support for an interactive mode in which you can enter results from a terminal right to the language, allowing interactive testing and debugging of snippets of code.
- **Portable:** Python can run on a wide variety of hardware platforms and has the same interface on all platforms.
- **Extendable:** You can add low-level modules to the Python interpreter. These modules enable programmers to add to or customer their tools to be more efficient.
- **Databases:** Python provides interfaces to all major commercial databases.
- **GUI Programming:** Python supports GUI applications that can be created and ported to many system calls, libraries and windows systems, such as Windows MFC, Macintosh and the X Window system of Unix.
- **Scalable:** Python provides a better structure and support for large programs than shell scripting

3. KEY DIFFERENCES BETWEEN C++ VS JAVA vs PYTHON

Now let us discuss some of the key differences between C++ Vs Java, as we proceed in this tutorial.

1) Platform Independence

- C++ is a platform dependent language. The source code written in C++ needs to be compiled on every platform.
- Java is platform-independent. Once compiled into byte code, it can be executed on any platform.
- Python is platform-independent language

2) Compiler and Interpreter

- C++ is a compiled language. The source program written in C++ is compiled into an object code which can then be executed to produce an output
- Java is a compiled as well as an interpreted language. The compiled output of a Java source code is a byte code which is platform-independent
- Python is Interpreted Programming Language.

3) Library Support

- C++ has limited library support
- Java provides library support for many concepts like UI
- Python has a huge set of libraries and modules.

4) Multiple Inheritance

- C++ supports various types of inheritances including single and multiple inheritances. Although there are problems arising from multiple inheritances, C++ uses the virtual keyword to resolve the problems.

- Java, supports only single inheritance. Effects of multiple inheritance can be achieved using the interfaces in Java.
- Python provides both single and multiple inheritances

5) Overloading

- In C++, methods and operators can be overloaded. This is static polymorphism.
- In Java, only method overloading is allowed. It does not allow operator overloading.
- Python supports operator overloading

6) Code Length

- In C++, Code length is a bit lesser, 1.5 times less than Java.
- Java has quite huge code.
- Python has Smaller code length, 3-4 times less than Java.

7) Execution Time

- C++ is very fast. It's, in fact, the first choice of competitive programmers
- Java is much faster than Python in terms of speed of execution but slower than C++.
- Due to the interpreter, Python is slow in terms of execution

8) Thread Support

- C++ doesn't have in-built thread support. It mostly relies on third-party threading libraries.
- Java has in-built thread support with a class "thread". We can inherit the thread class and then override the run method.
- Python supports multithreading

4. APPLICATIONS:

Both C++ and Java have vast areas of application. Below are the applications of both languages:

- **Applications of C++ Programming language:**
 - a. Suitable for Developing large software (like passenger reservation systems).
 - b. MySQL is written in C++.
 - c. For fast execution, C++ is majorly used in Game Development.
 - d. Google Chromium browser, file system, and cluster data processing are all written in C++.
 - e. Adobe Premiere, Photoshop, and Illustrator; these popular applications are scripted in C++.
 - f. Advanced Computations and Graphics- real-time physical simulations, high-performance image processing.
 - g. C++ is also used in many advanced types of medical equipment like MRI machines, etc.

- **Applications of Java Programming language:**

- a. Desktop GUI Applications development.
- b. Android and Mobile application development.
- c. Applications of Java are in embedded technologies like SIM cards, disk players, TV, etc.
- d. Java EE (Enterprise Edition) provides an API and runtime environment for running large enterprise software.
- e. Network Applications and Web services like Internet connection, Web App Development.

- **Applications of Python Programming language**

- a. Web Application
- b. Desktop and GUI Applications
- c. Console-based Applications
- d. Software Development
- e. Audio-Video based Application

5. PROGRAM EXAMPLE

5.1. C++ Program

File: main.cpp

```
#include <iostream>
using namespace std;
int main() {
    cout << "Hello C++ Programming";
    return 0;
}
```

Output:

Hello C++ Programming

5.2 JAVA Program

File: Simple.java

```
class Simple{
    public static void main(String args[]){
        System.out.println("Hello Java");
    }
}
```

Output:

Hello Java

5.3 PYTHON Program

```
class MyClass:
    x = 5

p1 = MyClass()
print(p1.x)
output:5
```

6. WHICH ONE IS BETTER C++ OR JAVA?

We cannot definitely say which is better. Both C++ and Java have their own merits and demerits. While C++ is mostly

good for system programming, we cannot do it with Java. But Java excels in applications like web, desktop, etc.

In fact, C++ can do anything from system programming to enterprise to gaming. Java can do more of a web or enterprise. There are some applications like certain low-level programming applications or gaming etc. which cannot be left for Java to develop.

Thus it totally depends on what application we are developing. The best way is to evaluate beforehand the pros and cons of both the languages and verify their uniqueness for the application that we are developing and then conclude which is the best

7. PYTHON BETTER THAN C++?

As far as language simplicity is concerned, Python is better than C++. Also, Python has huge built-in library support and is extensively used in Data Science and Machine Learning. While C++ is quite faster in terms of speed of execution. So overall it depends on the requirements if the target is to do Machine Learning, then go for Python. If the target is to do system programming, then go for C++.

8. WHICH IS BETTER PYTHON OR JAVA?

Having considered both languages against various parameters, it is not clear which language trumps the other one.

Java may be a more popular option, but Python is widely used. People from outside the development industry have also used Python for various organizational purposes. Similarly, Java is comparatively faster, but Python is better for lengthy programs.

Eventually, it depends upon the type of program a developer wants to create. If you consider the above parameters, and a language ticks most of your boxes, it is safe to go ahead with it. However, if you are beginning to foray into development, Python might be a better choice. On the other hand, Java will be the preferred option for enterprise-level programs.

9. . CONCLUSION

C++ , Java AND Python are object-oriented programming languages. In addition, C++ is a procedural language as well. There are some characteristics of C++ like closeness to hardware, better object management, speed, performance, etc. which makes it more powerful than Java and Python thus motivate the developers to use C++ for low-level programming, high-speed gaming applications, system programming, etc.

In a similar way, the easier syntax of Java, automatic garbage collection, lack of pointers, templates, etc. make Java a favorite for web-based applications.

The various implementations of Python also lead to the favorability of the language. By including the ability to use a Web framework, such as Django, or an enhanced IDE, such as PyCharm, the flexibility of the language and what a programmer can do with it is endless.

There is an endless debate regarding the best programming language; C++, Java, Python, or any other. Well, there can't be a single winner. This is because each programming language is designed to address distinct issues. The downside of doing this is that some issues remain unaddressed and hence might become the weakness for that language.

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